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THE QUIVERING EARTH.

AN INTERESTING CHAPTER ON EARTHQUAKES.

A Scientific Paper from Major Harry Hammond—Some Facts that Will Interest the Newspaper Reader—Earthquakes of Frequent Occurrence in the United States.

BEECH ISLAND, S. C., Aug. 3, 1886.

Hon. P. Walsh, Augusta, Ga.:—Dear Sir: I feel such compunction at seeing the space of your valuable journal occupied with my random talk of the other day, that I beg, as compensation, to enclose some paragraphs on earthquakes to you.

I have selected and very greatly condensed them from such mention as I find in my scientific periodicals of the last few years. I have not tried to arrange them in any order, and you can select and omit any as you may think proper. Ordinarily, I suppose, no one would read them, but just now perhaps these scientific observations may be of interest. The importance of earthquakes consist not in the property they destroy or the persons they kill, but in the impressions they produce on the mental and moral character of large bodies of people. Comparing small things with great, the fractures and dislocations they produce among the loose elements of human souls exceeds the alterations they work in the face of physical nature. I have no doubt the demoralization consequent on them has determined the fate of nations and the course of civilization. A scientific consideration of them might allay or dispel such evil influence, and I hope these notes will be of service to you. Very truly,

HARRY HAMMOND.

NOTES ON EARTHQUAKES.

Professor Fruchs records 123 earthquake shocks for the year 1884, of which 57 occurred in winter, 24 in spring, 21 in summer and 21 in autumn. There was little volcanic activity throughout the year.

Twentieth January, 1886. The Russian bark *Proseide*, latitude, 17° 04' N., longitude 69° 00' W., wind fresh N. E., water smooth, speed 10 knots, encountered a heavy shock, throwing the vessel to one side and causing it to ship a heavy sea. It lasted only a few seconds, and the wind shifted directly to the S. E., and died away, leaving it calm for the next three days.

Of 72 shocks in China, 48 occurred in the first and second quarters of the moon, 24 in the third and fourth. The 6th day of the moon shows the largest number, 12; none occurred on the 2d, 5th, 13th, 14th. It has been thought that storms on the Atlantic slope were most frequent on the young moon.

In Switzerland there were 116 shocks in 1880 and 1881; 49 in 1882; 19 in 1883. The schooner *Kosano* reports June 23, 1885, in lat. 29 degrees 14' N., long. 132 degrees 35' W., two heavy shocks of submarine earthquakes about one minute apart, causing the vessel to tremble violently. The sky was overcast and the sea smooth.

Fourteenth July, 1885, severe earthquake experienced in Bengal, lasting nearly a minute and killing seventy persons.

The centre of the Andalusian earthquake of December 25, 1884, was determined as lying between Granada and Malaga, and earth tremors extended as far as Rome and Brussels. Seventeen thousand buildings were injured, of which 4,000 were totally destroyed, 745 persons were killed and 1,485 wounded. The cause of this earthquake is thought to have been the percolation of water into the deep lying rocky strata in the valley of Zafarraya, where the heat converted it into vapor of high tension and generated the tremendous forces which exploded along lines radiating from Zafarraya as focus. These radiations are very nearly in the same directions as the surface strata of the region, whose courses are believed to accord with subterranean cracks, through which the water reaches the interior heat.

It has been suggested that the Coast Survey should sink deep vertical shafts at intervals to determine by observations made on them from time to time whether there was any movement or shifting of the superficial or deeper strata, resulting in changes of latitude and longitude.

In an earthquake observed in Tokio, Japan, 15th October, 1884, the most violent motions were over in ten seconds, but the oscillations continued with much force for some minutes afterwards. The greatest velocity was 6.8 centimetres per second and the greatest acceleration 21. If the amplitude had occurred in conjunction with the more usual period of three-fourths of a second, the destruction would have been immense. It was felt over an area of twenty thousand square miles.

Of 387 earthquakes observed by Prof. Milne in Japan, between October, 1881, and October, 1883, 795 occurred from January to March; 70 from April to June; 98 from July to September; 83 from October to December. They were most violent along the line of the river Tonegawa, in a flat alluvial plain, only a small number being felt in the mountains or in the vicinity of recent or active volcanoes. They were most frequent on the side which slopes down steeply under a deep ocean, and not on the opposite side where the slope is more gradual and the ocean shallow. The same relationship holds in South America. Earthquakes are also most frequent in Japan, where there is evidence of recent and rapid elevation of the land, and where numerous rivers are pouring out heavy quantities of sediment on the ocean bottom, perhaps it is this increased weight, depressing the strata seaward, which tells them up on the land side and causes the earth shakes.

The last earthquake on the island of Ischia was reckoned as coming from a depth of 3,000 to 3,200 feet at most.

In Switzerland, in 1880, there were 62 tremors or shocks in 21 earthquakes; and in 1881 the number was 163 shocks for 37 earthquakes. In the Ross-Ferrol scale they are arranged in ten grades, according to degree of violence—from very faint, only observable by an instrument—the Seismometer—to those overturning rock, forming fissures and mountain slides.

There are two methods of determining

the depth at which earthquakes originate. 1st. By estimates based on precise, delicate observations, determining a series of points in which the oscillations are felt at the same moment. Such observations are very difficult to obtain. 2d. Milne's plan by examination of the crack in the land after an earthquake and determining their points of convergence, which is also the points of origin.

Captain Delamoy, of the French Marine Artillery, maintains that the Krakatoa outburst resulted from the conjunction of Jupiter and the August swarm of meteors. He predicted violent earthquakes in 1886 from the malevolent influence of Saturn. (Bosh.)

"Science," vol. V., No. 106, contains the map of an earthquake occurring 2d January, 1885, and felt in Virginia and Maryland.

Earthquakes seem to show a preference for the night hours. Maximum 2 to 4 a. m.; minimum 12 to 2 p. m. Between 1873 and 1883, there are recorded as occurring in the United States and Canada, not including Alaska, 364 earthquakes. Of these 150 occurred on the Pacific slope, 69 in the great valley of the Mississippi, 147 on the Atlantic slope, making an average of one in two days for the whole region, and about one a month for the Atlantic slope. Doubtless many lighter tremors for each of these might have been noted by any one possessed of a seismoscope, an instrument devised for that purpose.

Prof. Ewing, of Tokio, Japan, says of earthquakes that: 1st. "The motion of the ground begins very gradually. 2d. An earthquake consists of many successive movements, and there is almost always no single large one which stands out prominently from the rest. 3d. The disturbance ends even more gradually than it begins. 4th. The range, the period and the direction of movement are exceedingly and irregularly variable during any one earthquake. 5th. The duration of the disturbance of the ground is rarely less than one minute, and is often several minutes. 6th. Even in somewhat destructive earthquakes the greatest displacement of a point on the surface of the soil is only some hundredths of an inch. 7th. The vertical motion is generally much less than the horizontal. 8th. An earthquake exerting a horizontal force against a mass equal to one-third of its weight, if regularly repeated, is sufficient to crack brick walls and sometimes throw down chimneys. 9th. The minds of the inhabitants of earthquake regions lose their calm equipoise; they become nervous, and the first shock sends them to the street or Cathedral for safety, so that the earthquake records itself in man's spiritual nature. 10th. The Messrs. Darwin having undertaken some lunar observations at Cambridge with very sensitive instruments could not proceed with them on account of the 'continual movements of the earth.' It was never really still. It quivered and throbbled and bent under the pendulum night and day. A situation at the bottom of a deep mine was then tried, but with no better success. It was probably never before imagined that when the barometer rises an inch over a land area like that of Australia, the increased load of air sinks the entire continent two or three inches. Over a like sea area the water surface may be depressed a foot or more. The tide exercises similar power, depressing the shore at the flood, and allowing it to rise at the ebb. The slight earthquake shock along the Atlantic slope 11th August, 1884, was fatal to several persons through nervous excitement. Countries where the rocky strata have preserved their original horizontal position as in the north of France, part of Belgium and most of Russia, are nearly exempt from earthquakes. While violent commotions are experienced in regions of highly inclined strata, especially where such inclination has been recently effected, as is the Alps, Italy and Sicily.

On the 3d of April, 1881, in the island of Seio, in the Egean sea, about noon, and in less than one hour, more than thirty villages wrecked by an earthquake, killing 9,000 people; there had been preliminary tremors during 1879 and 1880. The earthquake of Rio Bomba, in 1797, came silently but destroyed 30,000 people with great suddenness, throwing some of them up a cliff one hundred feet high. The wave caused by the Krakatoa eruption traveled 11,900 miles in twenty hours and fifty minutes. In 1868 the wave that destroyed Arequipa and Arica, and engulfed 300,000 people, crossed the Pacific ocean from Honolulu in twelve hours, at the rate of four hundred and fifty miles an hour.

The Smithsonian Reports, 1884, contains a complete account of all known concerning earthquakes, by Professor Rockwood.

M. M. D. Montessus writes in the *Revue Scientifique*, from Central America: "During my residence of four years in San Salvador I have been able to write the detailed history of 2,332 earthquakes, 137 volcanic eruptions, 27 rains of important towns, and the formation of 3 new volcanoes."

Professor Milne, of Tokio, Japan, recommends as an earthquake proof house, a one-story, strongly-framed timber house, with a light, flatish roof of shingles or sheet iron, the whole resting on a quantity of small cast-iron balls, carried on flat plates, bedded in the foundations. The chimneys might be made of sheet-iron, carried through holes free of the roof.

Earthquakes are vibrations or oscillations of the ground backwards and forwards, due to the passage of waves similar to those produced in a body of water by throwing a rock or stick into it. These waves spread out from the points of origin, in concentric circles of irregular shape due to the character of the successive impulses at the focus; to the nature of the strata through which they are transmitted; and to the interference of vibrations moving vertically and horizontally and returning. The particles of matter move forwards and back but a short distance, usually only a few hundredths of an inch, though Milne believes the displacement may sometimes be as much as a foot. The wave itself is propagated over extensive areas as from Spain to America in the Lisbon earthquake.

It is the motion of the wave particles and not the transit of the wave from place to place that does the damage. It was estimated that where the wave traveled at the rate of a thousand feet a second, or six hundred and eighty-two miles an hour, the movement of the particles of matter was only five feet per second, or eight miles an hour. Scientists attribute the origin of earthquakes to three causes. 1st. To the action of the sun and moon on the molten mass in the interior of the earth, causing tides in it which produce the shocks. This theory is now abandoned, or this cause is thought to be no longer active. 2d. To volcanic action. The pressure of gas and steam producing explosions and eruptions and consequent convulsions of the surrounding earth. This is a real and efficient cause in volcanic regions, but does not account for earthquakes where there is no evidence of volcanic activity, except in such cases as the recent earthquake in Andalusia, above referred to. 3d. To the action of what are known as organic forces—that is, the forces which determine the direction and dimensions of mountain chains and coast lines. While elevations and depressions of mountains and coasts have occurred at intervals throughout the world's history, it is now thought that their general outlines have been permanent, and the form of continents is due to the adaptation of the cooled and hardened surface to the still cooling and contracting interior, along the original wrinkles or lines of elevation and depression. All rocky strata being deposited from water, were at first horizontal; but as the interior of the earth cooled and contracted they followed it, becoming folded and inclined like the wrinkles on the skin of a drying lemon. Imagine such an inclined stratum several thousand feet in thickness, one end resting on the Blue Ridge Mountains at Cesar's Head or King's Mountains, from which, as may now be seen there, it broke off and slipped down untold ages ago; the other end shelving out into the sea over the Gulf Stream, where there has been another fracture, sinking the stratum suddenly several thousand feet into the depths of the sea.

Now the seaward end of this inclined stratum might be undermined by ocean currents, causing it to settle down anew and thus produce shocks of earthquake. Or the rains and the rivers continually washing away mountain, hill and plain, and transporting from them enormous weight of sediment, would deposit it on the seaward end of this inclined stratum, overload and crush it down, and thus produce earth shocks. Or a downward movement or settling of the seaward end from either of these or some other cause might tilt the stratum on the land through a portion or its whole extent and produce earth disturbances.

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THOUGHTS FOR THE MONTH.

SOME REASONABLE SUGGESTIONS FROM HIGH AUTHORITY.

What Work the Good Farmers Should Do in the Month of September—An Interesting Article From an Intelligent Writer.

(W. L. Jones in the September "Cultivator.")

We have discussed, in former numbers, preparation for all crops. The time has come for planting them. September is the natural and best seeding time for grasses, clover, lucern, oats, rye and barley. We say natural seeding time, because the seeds of the various plants enumerated are matured in the summer when it is hot and dry, and even if the heads are shattered and the seed scattered on the ground, the latter do not find proper conditions for germinating till the later rains set in and cool nights and heavy dews prevail. The earlier in the month these conditions are present the better it is, because ample time is furnished the young plants to establish themselves well and firmly in the soil before the frosts of winter. In a wild or uncultivated state these plants begin their growth at time indicated; this is nature's appointment, therefore, and is best suited to the wants of the plants. In northern latitudes, where hardest frosts prevail, snow protects the young plants during winter; in the South longer and stronger autumn growth must take the place of the snow covering.

As winter grasses abound more in northern than in southern latitudes, the conclusion seemed natural that the heat of southern climates was prejudicial to these plants; and one step further in the same direction seemed reasonable, to wit, that they needed shade in the South. Hence the practice of seeding grass and clover with small grains to get the benefit of their shade. Doubtless some shade is desirable during periods of intense heat and drought, but can it be procured in the manner spoken of, without incurring other injury greater than the good received when grass is sown with grain? Our observation is that more is lost than gained. In the first place the protecting shade is taken away just when most needed; grain is harvested in June and July when the greatest heat and severest droughts prevail. Plants accustomed to partial shade are then suddenly exposed to intense heat. But this is not all. In the case of grasses proper, the grain crops make demand upon the soil for exactly the same food the grasses need. Being larger and more vigorous at the start, the former over-master the grass at the beginning and get the lion's share of the food. At harvest, therefore, the grass is suddenly exposed to the fiercest rays of the sun when it is comparatively starved and weak from the unequal struggle. On exceedingly rich soils where there is ample food for both, this objection does not hold so strongly, but such soils are not generally found. This difficulty may in part be obviated by top-dressings in the spring. But where land is so abundant, ample enough for every crop a farmer could wish to cultivate, as a rule, it is better to sow the grasses by themselves and not in conjunction with grain crops. This gives them an opportunity of getting strong during the early stages of growth, when they are naturally weak, and puts them on vantage ground when the struggle with heat and drought begins. These remarks apply with greater force to the annual winter grasses and clovers which complete their growth in early spring. These of necessity must be sown by themselves, or with some crop which follows after them, but does not grow simultaneously with them.

We cannot urge too frequently upon beginners the importance of heavy seeding; be sure to sow enough for the plants to occupy all of the land—leave no place for intruders. Sow enough to allow for defective seed—for adulterated seed, and for the dying out of weak plants. After one has taken all the trouble of thorough preparation and heavy manuring—such as grass requires—it is folly to fall from insufficient seeding.

Very light covering of the seed is of the first importance; deep covering will certainly bring failure. But when lightly covered, seeds will not germinate well if the weather is dry, unless they are firmly pressed into the soil. Hence the importance of the roller. It is almost indispensable in grass culture; it smooths and levels the ground; for the mover, presses small seeds into the surface, hastens the germination of seeds, and imparts vigor to the young plants. Heavy, impacting rains may do some of the work of the roller, but in their absence the surface soil is too loose and too easily dried off for the little plant to establish itself in it. Remember, that at its first roots start at or very near the surface. It is not in the situation of a plant springing from a seed buried two or three inches below the surface.

The oat crop has been so often winter-killed of late that many are discouraged and disposed to abandon the practice of fall-sowing. We confess that recent experience has been very discouraging. But in view of the great value of the crop, when it does succeed we are loth to abandon it. We have faith in the action and cultivation of a winter oat capable of resisting extreme cold. What is known in Middle Georgia as "winter grazing oat" does certainly resist cold better than other varieties. In this locality, the past winter, the mercury descended to zero and the cold was long continued, and yet a good deal of the oat survived, and by its abundant tillering made from one-fourth to one-third of a crop. In most fields of rust-proof oats sown in autumn scattering stools could also be found, and that too in positions not specially sheltered. Now if, without selection and from indiscriminate sowings of seed, individual plants spring up with power to withstand intense cold, why, with proper care, could not a hardy variety be propagated and established from these cold-resisting plants? We have faith that it can be done, and our faith is based on facts like these, related by Darwin in his work on "Animals and Plants under domestication."

What quickly assumes new habits of life. The summer and winter habits were classed by Linnaeus as distinct species; but M. Monnier has proved that the difference between them is only temporary. He sowed winter wheat in spring, and out of one hundred plants four alone produced ripe seed; these were sown and re-sown, and in three years plants were reared which ripened all their seed. Conversely, nearly all the plants raised from summer wheat, which was sown in autumn, perished from frost; but a few were saved and produced seed; and in three years this summer variety was converted into a winter variety. Our habit has been to sow indiscriminately, as chance or convenience might decide, spring grown oats in the fall and fall grown oats in the spring. Is it any wonder that we have no fixed varieties adapted to either season? Some time ago we urged the careful sowing of all rust-proof oats that survived the past winter. We hope it has been done and that they will be sown this month, and the same thing repeated for at least three years.

The present crop covers all of our experience with the winter grazing oat. It was not ready to cut until the 10th of July, though sown on the 30th of October last. Possibly its having been thinned out by the cold, and the tillering consequent thereon, may have retarded its ripening. But although June was a very wet month and bunches of rye distributed through these oats were badly rusted, the oats had no rust whatever. We shall sow it again and watch results.

Neither barley nor rye were killed by the extreme cold of the past winter. To some extent, therefore, these can be made to take the place of fall oats—the poorer lands on the richer and rye on the poorer lands. With these cover the bare cotton fields during the winter and save them from washing and leaching. Simply harrow in the seed—don't break up the land and increase the facilities for washing. When green, these crops can be cut and fed to horses and cows; when mature they can be harvested, threshed and ground and make most excellent stock feed. Rye straw commands ready sale for filling in horse collars and other purposes, but the stalks and stock yards may well dispose of it all. Our soils cry aloud for humus—let us take every opportunity to supply it. Some one has suggested that oats and rye might be sown together—if the oats should be killed the rye would not and the land would still be occupied with a desirable crop. We see no objection except the unequal ripening of the two crops, but as rye will remain standing without waste for some time after it ripens it could wait on the oats. Upon the whole the suggestion strikes us as a good one, worthy of being tested by trial.

A friend has recently called our attention to the successful culture, in this vicinity, of a grass variously called "Schradler's grass," "Australian oats," "rescue grass," etc. Bromus unioloides or Schradler being its technical name. He spoke very highly of it as a winter grazing grass, growing very rapidly in early spring and producing a large quantity of broad, nutritious leaves. Though sometimes called "rescue" and resembling grass generally known by that name, it is said to be much larger and more luxuriant in its growth and decidedly more valuable. Our seedsmen here inform us that there is considerable demand for the seed in Louisiana and Texas, where it is very highly esteemed. It is said by some authorities to be perennial; by others to be an annual. We learn that it was partially killed here by the extraordinary cold of the past winter, but usual cold does not hurt it. It would probably thrive below the thirty-fourth degree of latitude.

This is the proper month in which to sow turn clover and crimson clover. Both of these are annuals, beginning growth in autumn when mature and die by the 1st of the following June. They are valuable plants, especially in localities where ordinary red clover will not thrive. Our friends below the head of navigation in our rivers could have as fine clover pastures in the spring, from these two plants, as could be seen anywhere. Make the ground rich, sow a plenty of seed in September and cover them lightly; that is the whole secret.

Towards the last of the month peavines and crab-grass will be ready for moving and curing. Farmers seem to be pretty generally of the opinion that peavines should not be cut until young peas form on them; that the leaves are less apt to drop off then and the vines more easily cured than at an earlier stage. If left too late the stems become very woody and hard, and are worthless as forage. Both extremes then are to be avoided. It is a difficult thing to cure and opinions vary as to the best method of doing it. If one has abundant house-room, or the means of providing cheap temporary shelters, it is unquestionably best to put the vines under cover as soon as they are fairly wilted, hanging them on poles, or arranging in some way so as to allow a free circulation of air. A lot with a slatted or open floor is an excellent place to cure this or any kind of forage. In the absence of the above appliances the vines may be put in small cocks—narrow but high—and if the weather is dry several of these may be thrown together into a large cock on the third or fourth day. Constant regard should be had to avoid exposing much surface to sun or dew. Hence high and narrow cocks are recommended. It is difficult to have them properly made by ordinary means; this is one of the things a farmer should personally supervise.

Crabgrass makes very good hay if cut at the proper time, which is just as the seeds are forming and before they are ripe. The seeds drop off readily when mature, and whatever of the substance of the plant passes into the seeds is thus lost. Out and cure, therefore, before the seeds will drop off and before the stalks become woody. They are too small to be still, but when old they become woody and worthless and lose their digestibility, just as over-ripe straw does.

A Popular Fallacy.

"An oyster is alive up to the moment that the knife is thrust through his heart; he is not," asked the reporter of the operator as the latter opened a shell and loosed a succulent Norfolk.

"The oyster is alive until the shell is broken," was the answer. "But the spirit you refer to as the heart is the eye. The heart is in the opposite end of the oyster to the pointed part. The month is near the eye, and it is at that end—the broad end—that the oyster takes his food."

species; but M. Monnier has proved that the difference between them is only temporary. He sowed winter wheat in spring, and out of one hundred plants four alone produced ripe seed; these were sown and re-sown, and in three years plants were reared which ripened all their seed. Conversely, nearly all the plants raised from summer wheat, which was sown in autumn, perished from frost; but a few were saved and produced seed; and in three years this summer variety was converted into a winter variety. Our habit has been to sow indiscriminately, as chance or convenience might decide, spring grown oats in the fall and fall grown oats in the spring. Is it any wonder that we have no fixed varieties adapted to either season? Some time ago we urged the careful sowing of all rust-proof oats that survived the past winter. We hope it has been done and that they will be sown this month, and the same thing repeated for at least three years.

The present crop covers all of our experience with the winter grazing oat. It was not ready to cut until the 10th of July, though sown on the 30th of October last. Possibly its having been thinned out by the cold, and the tillering consequent thereon, may have retarded its ripening. But although June was a very wet month and bunches of rye distributed through these oats were badly rusted, the oats had no rust whatever. We shall sow it again and watch results.

Neither barley nor rye were killed by the extreme cold of the past winter. To some extent, therefore, these can be made to take the place of fall oats—the poorer lands on the richer and rye on the poorer lands. With these cover the bare cotton fields during the winter and save them from washing and leaching. Simply harrow in the seed—don't break up the land and increase the facilities for washing. When green, these crops can be cut and fed to horses and cows; when mature they can be harvested, threshed and ground and make most excellent stock feed. Rye straw commands ready sale for filling in horse collars and other purposes, but the stalks and stock yards may well dispose of it all. Our soils cry aloud for humus—let us take every opportunity to supply it. Some one has suggested that oats and rye might be sown together—if the oats should be killed the rye would not and the land would still be occupied with a desirable crop. We see no objection except the unequal ripening of the two crops, but as rye will remain standing without waste for some time after it ripens it could wait on the oats. Upon the whole the suggestion strikes us as a good one, worthy of being tested by trial.

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